ANFOS

ANFO is an acronym for Ammonium Nitrate - Fuel Oil Solution. An ANFO solves the only other major problem with ammonium nitrate: its tendency to pick up water vapor from the air. This results in the explosive failing to detonate when such an attempt is made. This is rectified by mixing 94% (by weight) ammonium nitrate with 6% fuel oil, or kerosene. The kerosene keeps the ammonium nitrate from absorbing moisture from the air. An ANFO also requires a large shockwave to set it off.

About ANFO (From Dean S.)

Lately there was been a lot said about various ANFO mixtures. These are mixtures of Ammonium Nitrate with Fuel Oil. This forms a reasonably powerful commercial explosive, with its primary benifit being the fact that it is cheap. Bulk ANFO should run somewhere around 9-12 cents the pound. This is dirt cheap compared to 40% nitro gel dynamites at 1 to 2 dollars the pound. To keep the cost down, it is frequently mixed at the borehole by a bulk truck, which has a pneumatic delivery hopper of AN prills (thats pellets to most of the world) and a tank of fuel oil. It is strongly recommended that a dye of some sort, preferably red be added to the fuel oil to make it easier to distinguish treated AN explosive from untreated oxidizer.

ANFO is not without its problems. To begin with, it is not that sensitive to detonation. Number eight caps are not reliable when used with ANFO. Booster charges must be used to avoid dud blast holes. Common boosters include sticks of various dynamites, small pours of water gel explosives, dupont's detaprime cast boosters, and Atlas's power primer cast explosive. The need to use boosters raises the cost. Secondly, ANFO is very water susceptable. It dissolves in it, or absorbes it from the atmosphere, and becomes quite worthless real quick. It must be protected from water with borehole liners, and still must be shot real quick. Third, ANFO has a low density, somewhere around .85. This means ANFO sacks float, which is no good, and additionally, the low density means the power is somewhat low. Generally, the more weight of explosive one can place in a hole, the more effective. ANFO blown into the hole with a pneumatic system fractures as it is places, raising the density to about .9 or .92. The delivery system adds to the cost, and must be anti static in nature. Aluminum is added to some commercial, cartridge packaged ANFOs to raise the density---this also raises power considerable, and a few of these mixtures are reliablly cap sensitive.

Now than, for formulations. An earlier article mentioned 2.5 kilos of ammonium nitrate, and I believe 5 to 6 liters of diesel. This mixture is extremely over fueled, and I'd be surprised if it worked. Dupont recommends a AN to FO ratio of 93% AN to 7% FO by weight. Hardly any oil at all. More oil makes the mixture less explosive by absorbing detonation energy, and excess fuel makes detonation byproducts health hazzards as the mixture is oxygen poor. Note that commercial fertilizer products do not work as well as the porous AN prills dupont sells, because fertilizers are coated with various materials meant to seal them from moisture, which keep the oil from being absorbed.

Another problem with ANFO: for reliable detonation, it needs confinement, either from a casing, borehole, etc, or from the mass of the charge. Thus, a pile of the stuff with a booster in it is likely to scatter and burn rather than explode when the booster is shot. In boreholes, or reasonable strong casings (cardboard, or heavy plastic film sacks) the stuff detonated quite well. So will big piles. Thats how the explosive potential was discovered: a

small oil freighter rammed a bulk chemical ship. Over several hours the cargoes intermixed to some degree, and reached critical mass. Real big bang. A useful way to obtain the containment needed is to replace the fuel oil with a wax fuel. Mix the AN with just enough melted wax to form a cohesive mixture, mold into shape. The wax fuels, and retains the mixture. This is what the US military uses as a man placed cratering charge. The military literature states this can be set off by a blasting cap, but it is important to remember the military blasting caps are considerable more powerful than commercial ones. The military rightly insists on reliability, and thus a strong cap (maybe 70-80 percent stronger than commercial). They also tend to go overboard when calculating demolition charges...., but then hey, who doesn't....

Two manuals of interest: Duponts "Blaster's Handbook", a $20 manual mainly useful for rock and seismographic operations. Atlas's "Powder Manual" or "Manual of Rock Blasting" (I forget the title, its in the office). This is a $60 book, well worth the cash, dealing with the above two topics, plus demolitions, and non-quarry blasting.

Incidently, combining fuel oil and ammonium nitrate constitutes the manufacture of a high explosive, and requires a federal permit to manufacture and store. Even the mines that mix it on site require the permit to manufacture. Those who don't manufacture only need permits to store. Those who don't store need no permits, which includes most of us: anyone, at least in the US may purchase explosives, provided they are 21 or older, and have no criminal record. Note they ought to be used immediately, because you do need a liscence to store. Note also that commercial explosives contain quantities of tracing agents, which make it real easy for the FBI to trace the explosion to the purchaser, so please, nobody blow up any banks, orphanages, or old folks homes, okay.

D. S.- Civil Engineer at large.

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